Committee on Resources,

Subcommittee on Energy & Mineral Resources

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Witness Statement

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Madam Chairman and distinguished Members of the Subcommittee, thank you for the opportunity to participate in this hearing and to present the results of the U.S. Geological Survey's (USGS) assessment of coalbed methane resources of the U.S. This assessment of undiscovered coalbed methane resources is a fundamental part of the USGS National Oil and Gas Assessment, completed in 1995, which has now been updated with recent assessments of the Uinta-Piceance Basin, Colorado and Utah and the Powder River Basin, Wyoming and Montana.

The Nature of Coalbed Methane

Coal is the most abundant fossil fuel, with global reserves estimated to be several trillion tons. In addition to minable reserves, coal is considered to be a source of fluid hydrocarbons, in particular the lightest hydrocarbon gas, methane. Methane is the dominant component in natural gas. The methane that forms in coal is produced by chemical reactions that proceed as a consequence of increasing temperature during the burial of the coal in a sedimentary basin, or may be produced by the action of bacteria that derive their nutrition from the coal and generate methane as a by-product.

Although coal is a solid, it is quite porous, and the pores and fractures in coal may hold enormous volumes of methane. The methane in coal is generally held in the pore spaces by water pressure. As long as water is present, the methane remains in the coal. When the water pressure is reduced, the methane is released and may flow through the fractures in the coal to the surface or to a well bore.

The buildup of methane gas in coal mines during the mining process was recognized very early in coal mining history. The fires or explosions that tragically proved the presence of the methane gas have historically posed chronic coal production problems and danger to human life. Only within the last few decades has methane in coal beds been recognized as a significant untapped energy resource that might be produced.

Not all types of coal may be suitable for producing coalbed methane, however. If coal is too deep in a basin, it becomes effectively sealed and the gas cannot be released from the coal. In addition, deep coal would require deep drilling and the low productivity of coalbed methane wells (small volumes of gas per well per day compared to conventional natural gas wells) generally requires shallower, less expensive, development. Also, coal is highly variable in its chemical composition and physical structure. Certain types of organic matter are more prone to form methane, and the porosity of the coal must permit movement of the gas once it is released. Therefore, only certain coal beds, and perhaps in certain zones, are highly prospective for coalbed methane production.

DISTRIBUTION, ASSESSMENT, AND DEVELOPMENT OF COALBED METHANE RESOURCES

The USGS has, as a major part of its mission, the responsibility to estimate, or assess, the amounts of undiscovered oil and natural gas remaining in all onshore areas of the U.S. and in state-owned waters. These assessments are estimates of the quantities of oil and natural gas that have not yet been discovered, but which might be added to the reserves of the United States in the future. These assessments are based on the identification of favorable geologic conditions for the formation and accumulation of oil and gas. Assessments are conducted by teams of geoscientists who possess a thorough understanding of the geologic processes and environments that produce oil and natural gas. The USGS periodically releases updated estimates of oil and gas based on the latest available data and the most refined assessment methodologies. An important component of the ongoing USGS National Oil and Gas Assessment is an estimate of the technically recoverable coalbed methane resources in the United States.

The goal of the USGS National Oil and Gas Assessment is to anticipate the occurrence of undiscovered volumes of natural gas, including coalbed methane, and to estimate the volume of gas left to be discovered and recovered. By conducting geologic studies of the basins within the U.S., these assessments provide some indication of the future supplies of natural gas that may be produced within the next generation or so. The results of the coalbed methane assessment conducted in 1995 are shown in the table 1, and key basins are being updated on an ongoing basis.

Table 1. Technically recoverable (not constrained by cost of production) undiscovered resources of gas estimated for continuous-type plays in coal beds, onshore United States. All data from the USGS National Oil and Gas Assessment, 1995. [Mean value totals may not be equal to the sums of the component means given elsewhere because numbers have been independently rounded. Fractile values (F95, F5) are not additive. F95 represents a 19 in 20 chance and F5 represents a 1 in 20 chance of the occurrence of at least the amount tabulated.]

Province name (trillion cubic feet)

F95 F5 Mean

Region 2--Pacific Coast

Bellingham (WA, OR) 0 0.09 0.04

West Cascade (WA, OR) 0 1.20 0.66

Total, Region 2 0.26 1.30 0.70

Region 3--Colorado Plateau and Basin and Range

Uinta Basin (UT, CO) 1.86 4.82 3.21

Piceance Basin (CO, UT) 5.47 10.09 7.49

San Juan Basin (NM, CO) 5.76 9.67 7.53

Total, Region 3 15.00 21.88 18.24

Region 4--Rocky Mountains and Northern Great Plains

Powder River Basin (WY, MT) 0.32 2.90 1.11

Wind River Basin (WY) 0.22 0.72 0.43

S.W. Wyoming (WY, UT, CO) 0.83 7.66 3.89

Raton Basin (CO, NM) 1.39 2.23 1.78

Total, Region 4 3.97 11.71 7.20

Region 7--Mid-continent

Forest City Basin (KS, MO, IA, NE) 0 1.44 0.45

Cherokee Platform (KS, OK) 1.07 3.08 1.91

Arkoma Basin (OK, AR) 1.87 3.58 2.64

Total, Region 7 3.57 6.76 5.01

Region 8--Eastern

Illinois Basin (IL, IN, KY) 0.84 2.77 1.63

Warrior Basin (AL, MS) 1.49 3.43 2.30

North Appalachian (PA, NY, OH) 7.68 16.36 11.48

Central Appalachian (PA, OH, KY,WV, VA) 1.88 4.64 3.07

Cahaba (TN, AL, GA) 0.14 0.54 0.29

Total, Region 8 14.34 24.00 18.78

TOTAL, lower 48 States 42.89 57.63 49.91

The USGS has reassessed two important coalbed-methane bearing basins in the Rocky Mountains: the Uinta-Piceance Basin in Utah and Colorado and the Powder River Basin in Wyoming and Montana. We estimate that the Uinta and Piceance Basins contain, at the mean, 2.32 trillion cubic feet (tcf) of undiscovered, technically-recoverable coalbed methane (Table 2). This new estimate is a substantial reduction from our 1995 estimate of 10.70 tcf (Table 1).

In contrast, our estimate of undiscovered coalbed methane in the Powder River Basin has increased substantially. The USGS now estimates the Powder River Basin contains 14.26 tcf of undiscovered, technically-recoverable coalbed methane (Table 2), compared with 1.11 tcf reported in the 1995 National Oil and Gas Assessment (Table 1).

New estimates of undiscovered, technically-recoverable coalbed methane resources reflect new information about the geology of the basin and the extent of the resources made available from recent exploration and drilling activity in these basins, combined with advances in gas recovery technology in the shallow deposits of the Powder River Basin.

Table 2. Updated (2001) assessment values (trillion cubic feet) for undiscovered, technically-recoverable coalbed methane resources in the Uinta-Piceance Basin and the Powder River Basin.

Basin	**F_{95}**	**F_5**	**Mean**
Uinta-Piceance Basin (CO, UT)	1.16	4.07	2.32
Powder River Basin (WY, MT	8.24	22.42	14.26

Nationally, the major coalbed methane provinces coincide with the major coal provinces. The geology of coalbed methane is based upon the geology of the coal in which it forms and accumulates. The USGS has also conducted regional assessments of coal resources, including detailed research on the accumulation, burial, and subsequent uplift of coal that occurs across the U.S. Although coalbed methane is a form of natural gas, its accurate assessment rests upon the assessment of coal in U.S. basins; coal assessment provides an ideal basis for the subsequent assessment of coalbed methane. Although the presence of abundant coal does not guarantee that coalbed methane will be economically recoverable, the presence of coal is an obvious prerequisite for coalbed methane formation and accumulation in economic deposits. Therefore, the major coal provinces, such as the Appalachian Basin, the Texas Gulf Coast, the Colorado Plateau, and the Tertiary basins of the Northern Rockies and Great Plains, provide the most prospective areas for coalbed methane production (see map).

In addition to the undiscovered, technically recoverable coalbed methane volumes reported in Table 1, coalbed methane also comprises part of current U.S. natural gas reserves and production. Nationally, coalbed methane accounts for approximately 8% of total natural gas reserves and 7% of total natural gas production. Historically, the San Juan Basin has been the most productive coalbed methane basin in the U.S., accounting for approximately two-thirds of the known reserves and approximately 80% of the coalbed methane production (source, Energy Information Administration, (EIA), 2000). The second most productive area of the country, Warrior Basin in Alabama, accounts for approximately 8% of total coalbed methane reserves and 9% of U.S. coalbed methane production. (Table 3, EIA, 2000)

Table 3. U.S. Coalbed Methane Proved Reserves and Production, 1989-1999

(Billion Cubic Feet at 14.73 pounds per square inch atmospheric pressure (psia)

and 60° Fahrenheit)

	Alabama		**Colorado**		**New Mexico**		**Others[a]**		**Total**	
Year	**Reserves**	**Prod**	**Reserves**	**Prod**	**Reserves**	**Prod**	**Res**	**Prod**	**Reserves**	**Prod**
1989	**537**	**23**	**1,117**	**12**	**2,022**	**56**	**0**	**0**	**3,676**	**91**

1990	**1,224**	**36**	**1,320**	**26**	**2,510**	**133**	**33**	**1**	**5,087**	**196**
1991	**1,714**	**68**	**2,076**	**48**	**4,206**	**229**	**167**	**3**	**8,163**	**348**
1992	**1,968**	**89**	**2,716**	**82**	**4,724**	**358**	**626**	**10**	**10,034**	**539**
1993	**1,237**	**103**	**3,107**	**125**	**4,775**	**486**	**1,065**	**18**	**10,184**	**752**
1994	**976**	**108**	**2,913**	**179**	**4,137**	**530**	**1,686**	**34**	**9,712**	**851**
1995	**972**	**109**	**3,461**	**226**	**4,299**	**574**	**1,767**	**47**	**10,499**	**956**
1996	**823**	**98**	**3,711**	**274**	**4,180**	**575**	**1,852**	**56**	**10,566**	**1,003**
1997	**1,077**	**111**	**3,890**	**312**	**4,351**	**597**	**2,144**	**70**	**11,462**	**1,090**
1998	**1,029**	**123**	**4,211**	**401**	**4,232**	**571**	**2,707**	**99**	**12,179**	**1,194**
1999	**1,060**	**108**	**4,826**	**432**	**4,080**	**582**	**3,263**	**130**	**13,229**	**1,252**

[a]Includes Oklahoma, Pennsylvania, Utah, Virginia, West Virginia, and Wyoming.

Source: Energy Information Administration, Office of Oil and Gas, U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves:1999 Annual Report, 2000

This picture is changing, however, with the emergence of other western U.S. coalbed methane basins. In the Rocky Mountain region, the Powder River Basin in Wyoming is experiencing a coalbed methane production boom. The thick coals of the Powder River Basin in Wyoming and Montana are proving to be fertile areas for coalbed methane exploration and production. Coal beds with producible methane are often shallow in this basin, so wells are inexpensive to drill and operate. Although highly variable in thickness, the Tertiary coals in the Powder River Basin are commonly quite thick, reaching 300 feet thick in parts of the basin.

Exploration and production activity in the Powder River Basin began to increase geometrically once coalbed methane developers understood the production techniques necessary to successfully produce the gas. In May of 1994, there were 110 coalbed methane wells in the basin, producing 6.5 million cubic feet of gas per day, as well as 949,637 gallons of water per day. In May of 2001, seven years later, there were 5,446 wells producing 642 million cubic feet of coalbed methane per day and 61,141,720 gallons of water per day. The large volumes of water are produced because it is the water that holds the methane in the pores of the coal, and water must be removed in order for the gas to be released. Therefore, the first stage of production in a coalbed methane well in the Powder River Basin is the removal of sufficient water to release the gas so that it can be produced.

Impacts and Issues of coalbed methane Development

As a result of this water production, one of the major concerns associated with coalbed methane production in the Powder River Basin has been disposal of the co-produced water (water produced as a byproduct of the gas production). The coal beds in this basin are significant aquifers because of their high porosity and highly fractured character. Many local residents have historically taken their water supply from coal beds. However, the ground water table must be drawn down during coalbed methane production for the methane to be released from the coal. This draw-down requires many closely-spaced wells, sometimes pumping at high rates.

The water within the coals in the southeastern quadrant of the Powder River Basin in east central Wyoming is high quality water, suitable for drinking and agriculture, but the water in coals elsewhere in the basin may not be of such high quality. In these cases, the water must undergo treatment if it is to be disposed of on the surface, or it must be re-injected into a deep formation so that it does not contaminate the surface or ground water. Even some highly dilute waters may be undesirable because of salts that may be concentrated during evaporation if surface disposal is used. Therefore, it is essential to understand the chemistry of waters co-produced with coalbed methane and to dispose of those waters appropriately.

In the San Juan Basin, the water is rarely of sufficiently high quality that it can be disposed of on the surface. This is the situation in most other basins in the U.S. In addition, many states require that all co-produced fluids be re-injected into subsurface formations, regardless of the quality of the fluid. The production of large volumes of water and the need to develop appropriate methods for its disposal strongly affect the economic viability of coalbed methane wells. Because coalbed methane wells generally produce at lower rates than conventional natural gas wells, the expense of disposing of the co-produced waters may be economically prohibitive and could render the well uneconomic.

In areas where the co-produced water is high quality, such as in portions of the Powder River Basin, the main issue may be the effect of surface disposal of large volumes of water. Even though the water is clean, it affects the environment in this semi-arid climate. Co-produced water from coalbed methane development is presently discharged either directly into existing surface waters or to drainages. It is expected that surface disposal of co-produced water may result in erosion or drowning of drainages and associated vegetation within the area. Several companies have been experimenting with reinjecting the co-produced water into sandstones and coal beds in the Wasatch and Fort Union Formations. One company is reinjecting water into an aquifer used by the city of Gillette, Wyoming.

Ground water withdrawal from aquifers is a particularly sensitive issue to landowners who "beneficially use" ground water for their livestock and for irrigation (in addition to drinking water). Generally, methane operators have cooperated with landowners by diverting co-produced water from coalbed methane wells into stock tanks or other holding areas for their livestock.

Additionally, according to EPA, some citizens in areas with coalbed methane development have reported ground water well contamination they believe is due to hydrolic fracturing resulting from coalbed methane production. While no incidents of contamination allegedly due to hydraulic fracturing have ever been substantiated, EPA is currently conducting a study on possible impacts to ground water from hydraulic fracturing in coalbed methane reservoirs. USGS has agreed to provide assistance to EPA with that study.

Another impact of coalbed methane development is the affect on local coal mining operations of ground water withdrawal from the coal. Although this does not affect the amount of coal that is produced, it reduces the available water for coal mining operations and accelerates oxidation of the coal, which may reduce its heat content and energy potential. In addition, because surface mining activities involve the drawing down of the water table, reservoir pressures can be reduced, resulting in the liberation of the methane from the coal, which may escape along the active face of the mine. For example, there are 18 large surface coal mines along the eastern part of the Campbell County and the northernmost part of Converse County, Wyoming. Last year, these coal mines produced about 300 million short tons from the Wyodak-Anderson coal zone. The Wyodak-Anderson coal zone is also being explored and developed for coalbed methane by about 80 methane operators basin wide. The coal produced from these mines made up about 30 percent of the total U.S. coal production in 2000 and was shipped to more than 140 electric-power generating plants in the western, mid-western, southern, and southeastern U.S.

More than half of the lands in the Powder River Basin contain mineral rights owned by the Federal government, yet the majority of the surface in the basin is privately owned. As a result, the majority of coalbed methane wells are on state and private surface lands; only 14 percent of the wells are on Federallyowned surface lands. Coalbed methane development on Federal lands creates impacts in the basin resulting from associated drilling, facilities, methane gathering systems (e.g., pipeline networks), access roads, and withdrawal and disposal of co-produced water from coalbed methane wells. The Bureau of Land Management (BLM) assesses the land-use management and impacts of drilling coalbed methane wells on lands where mineral rights are controlled by the Federal government.

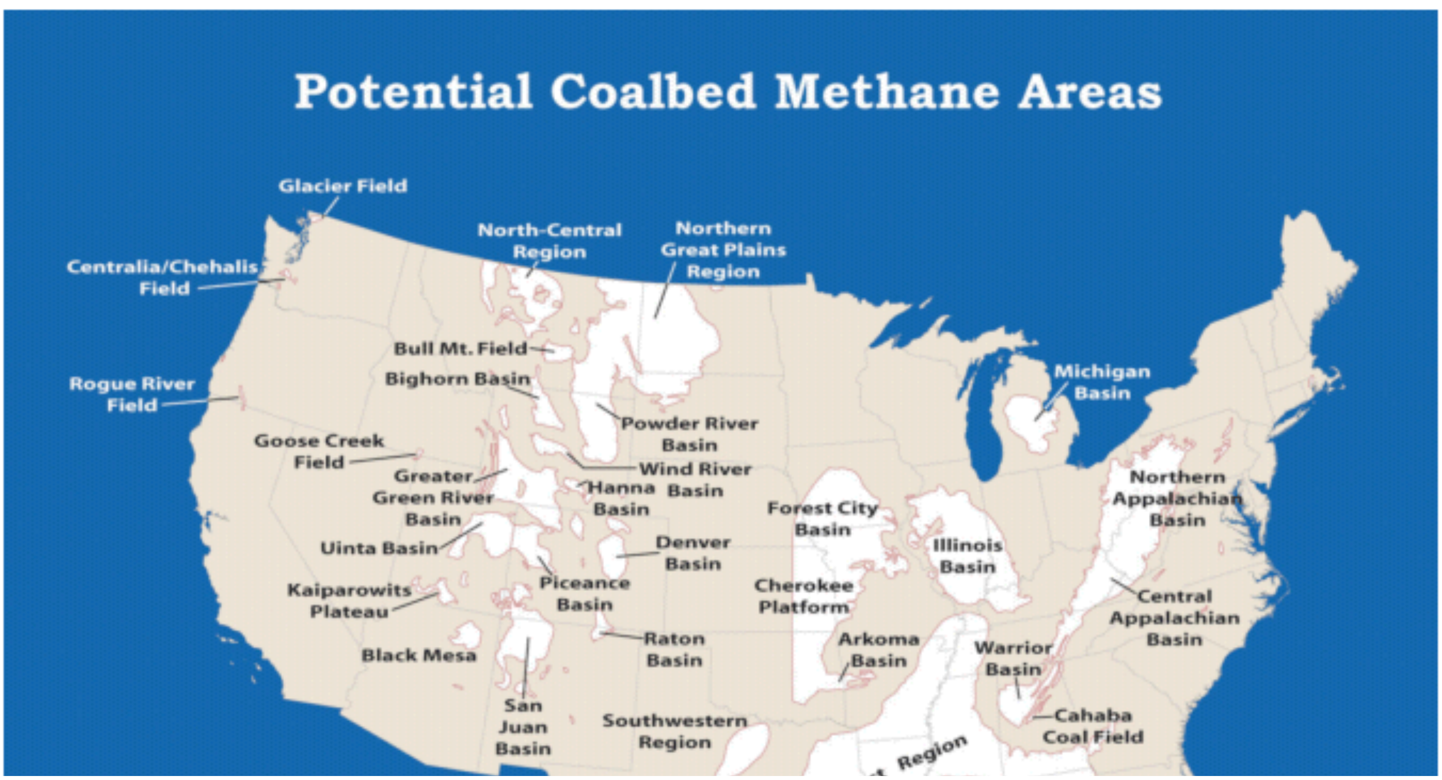
The BLM and the USGS initiated a cooperative project to collect technical data for analysis and evaluation of coalbed methane resources and reservoirs in the Powder River Basin, primarily from coal cores provided by cooperating coalbed methane operators. BLM and USGS use this

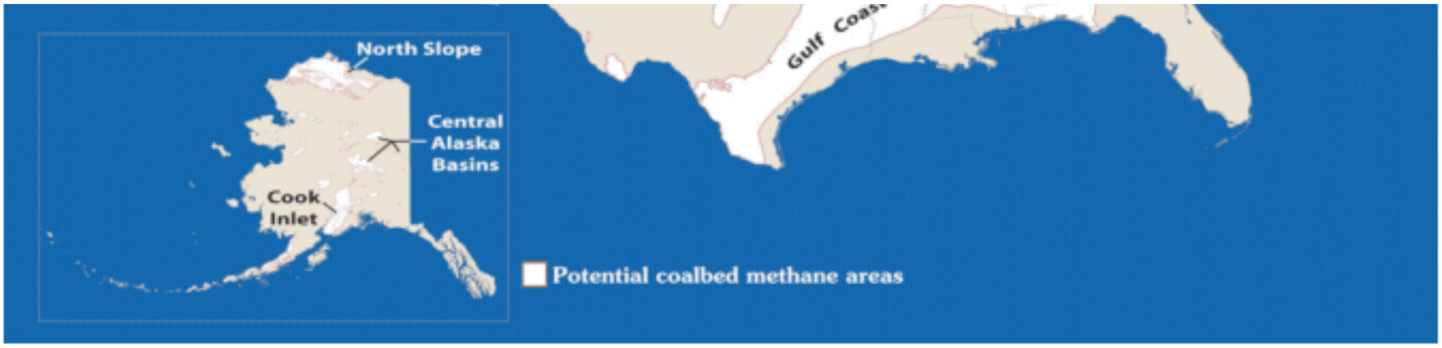
opportunity for additional information and analyses of the coalbed methane resources to accomplish their agencies' respective resource evaluation and management missions. The agencies have different, but complementary, goals and information needs. Their joint study also addresses public need for data regarding Powder River Basin coalbed methane resources.

SUMMARY

Coalbed methane is different from other types of natural gas deposits in its distribution, in its production methods, and in its environmental impact. Coalbed methane occurs in coal, is economically producible where it is shallow, and requires dewatering of the coal prior to production. Water co-produced prior to and during gas production must be re-injected into a deep formation or, if the water is sufficiently good quality, disposed of on the surface. Consequences of surface disposal of fresh water include some potential chemical effects after evaporation, the introduction of water into a semi-arid environment, and potential ground water depletion.

Madam Chairman, this concludes my remarks. I would be happy to respond to questions Members of the Committee may have.




North Slope
Central
Alaska
Basins
Cook
Inlet
Gulf Coast
Potential coalbed methane areas

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